Arthur D Little

CONCEPTS NREC

DOE New Project Kickoff

Compressor/Expander Technologies

Hybrid TurboScroll Compressor/Expander Module Development Program

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Arthur D. Little, Inc., in collaboration with Concepts NREC, is embarking on a program to develop an improved compressor/expander module for pressurized fuel cells.

- Arthur D. Little, Inc. will be the prime contractor, with Concepts NREC as turbo-machinery subcontractor and Scroll Corporation as scroll compressor design subcontractor
- For questions, please contact the Principal Investigator:

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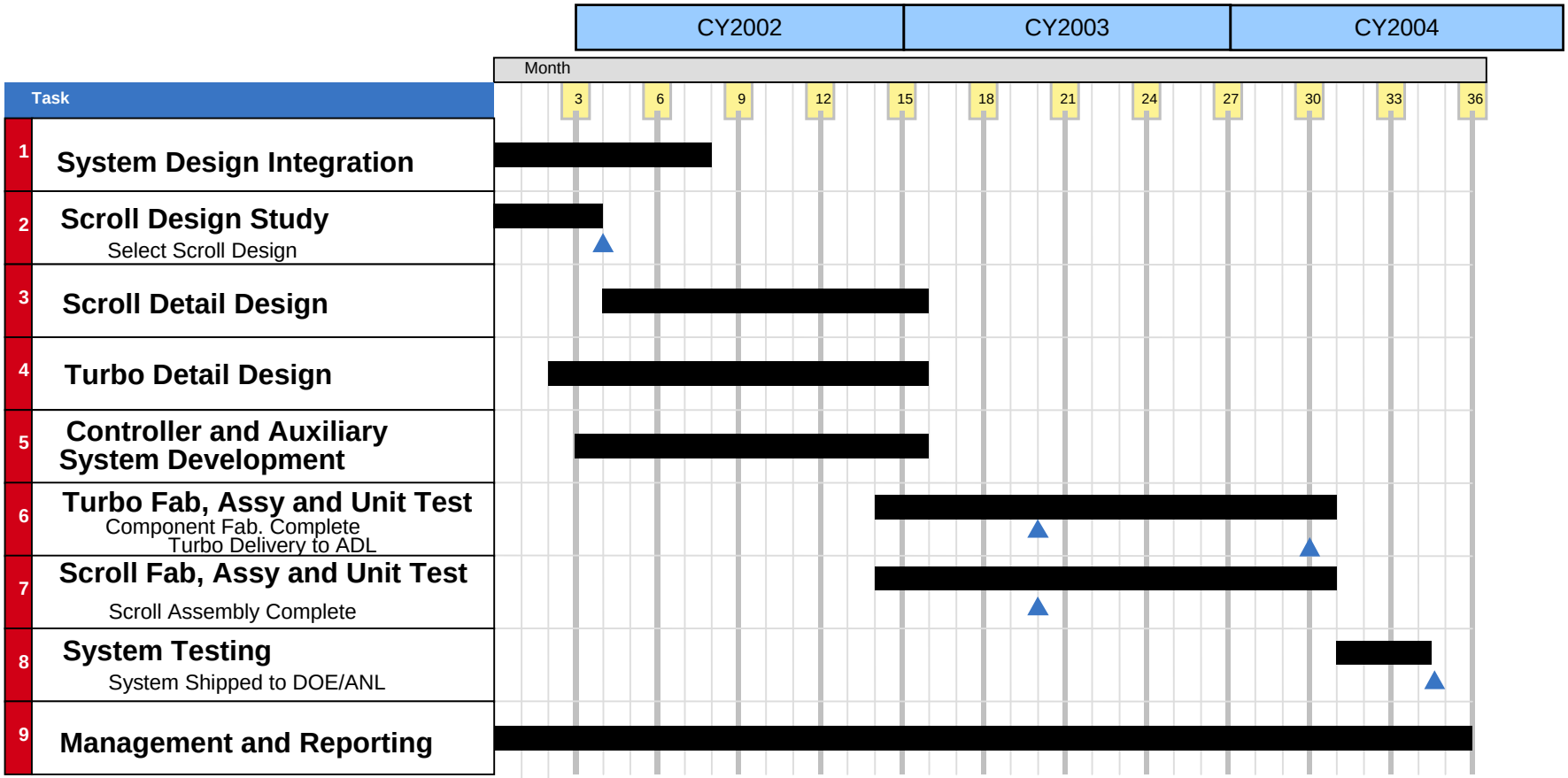
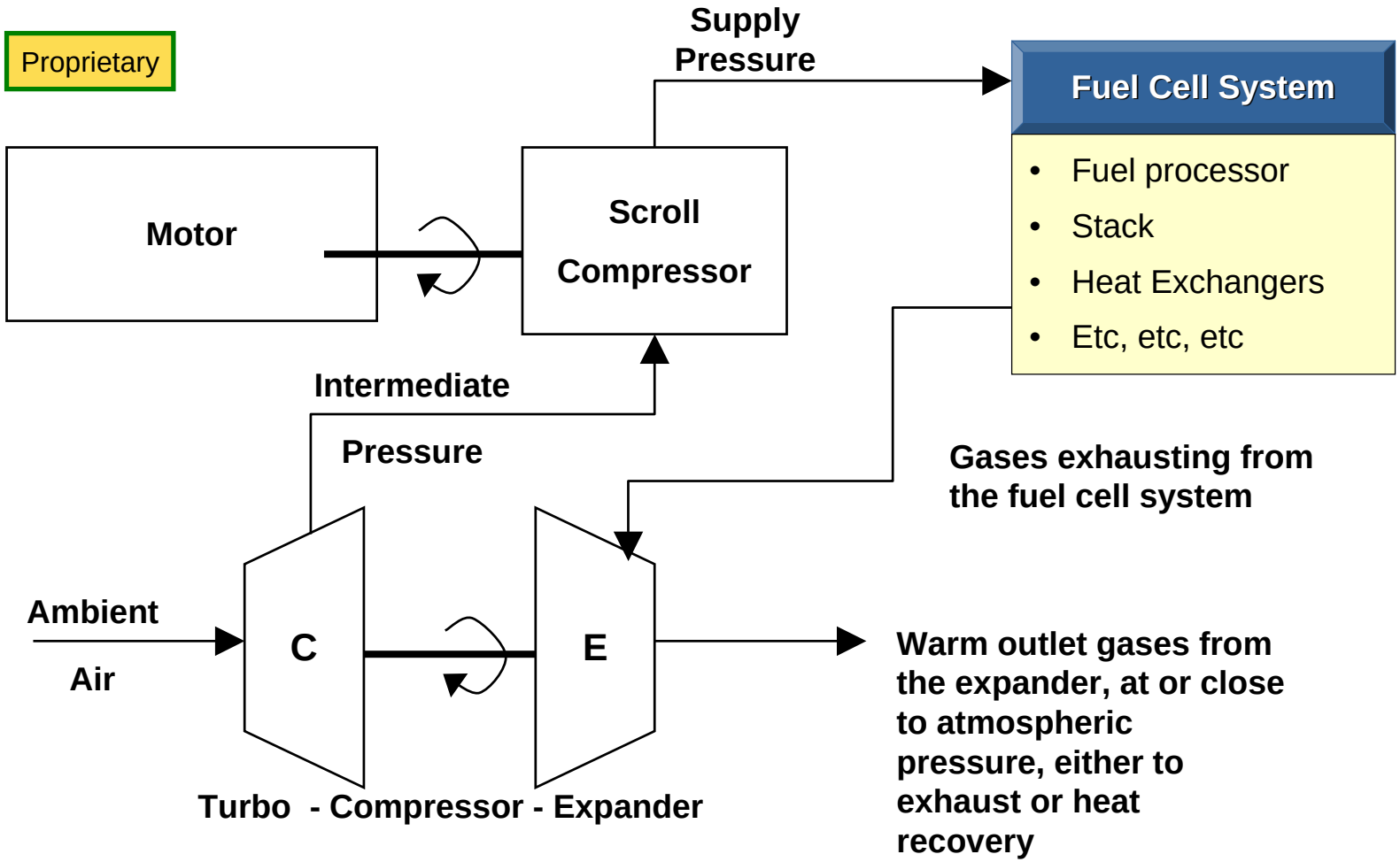
Our total funding profile of $2.2 million over three years includes a 25% contractor cost share for prime and sub-contractors.

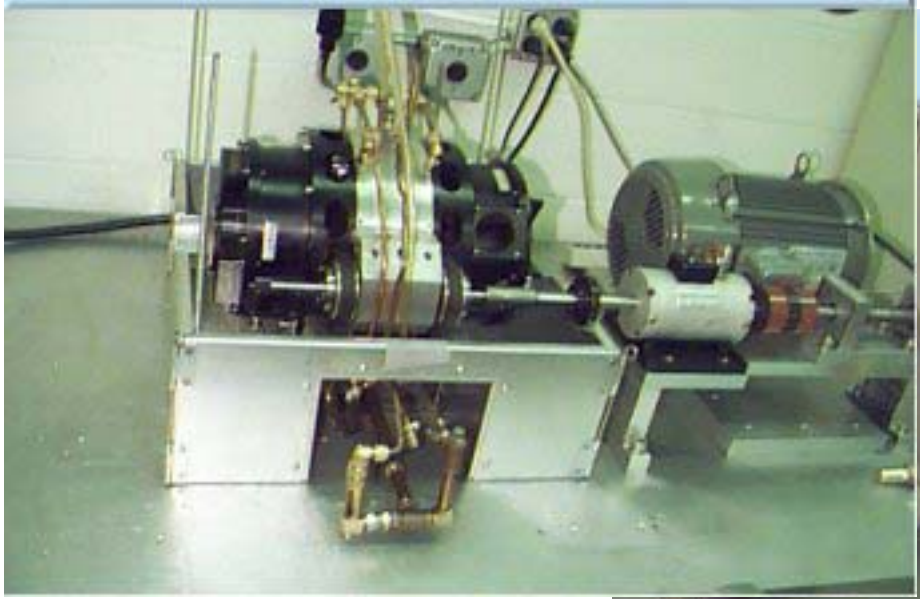


The objective of this program is to design, build and test a novel Compressor/Expander Module (CEM) system that combines the strengths of turbo-compression and scroll compression technologies.

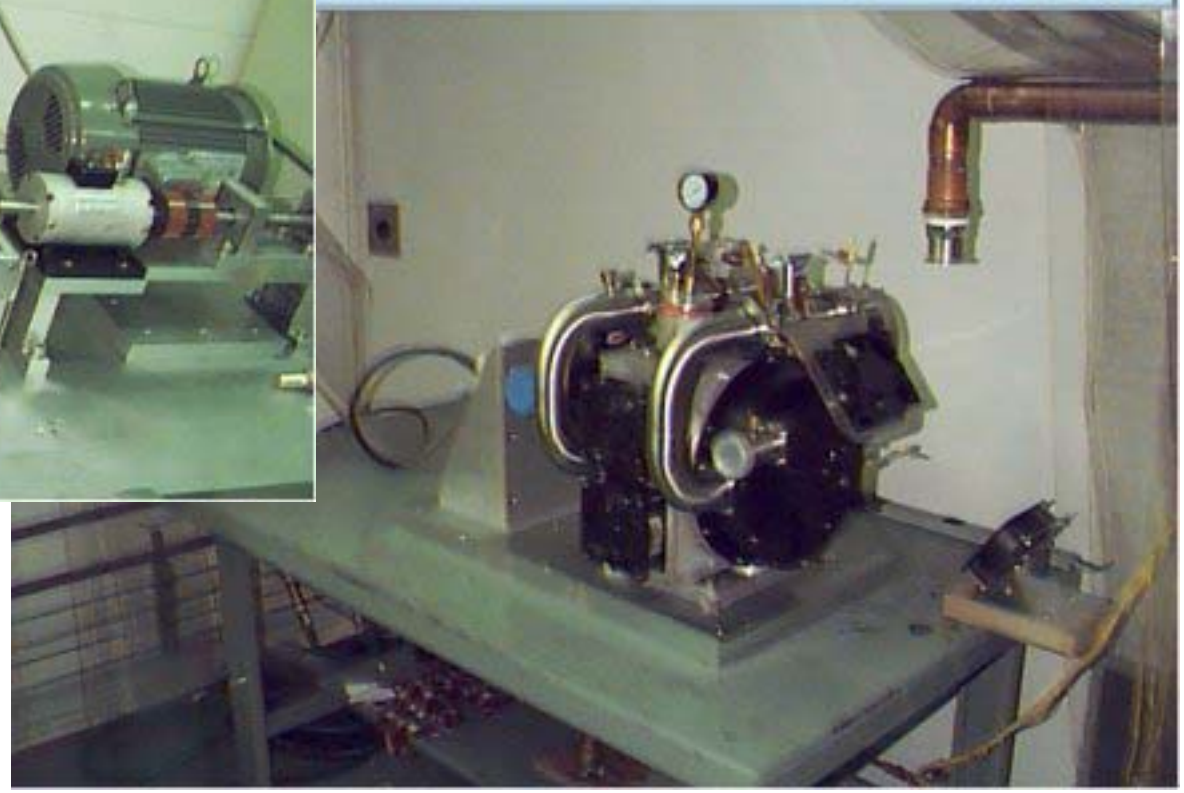


This system configuration arises out of two generations of scroll-based fuel cell CEM development with DOE.

First Generation Integrated CEM Prototype



Second-Generation CEM Prototype



The integration of a positive-displacement scroll compressor with a modified turbocharger is the essential concept of this hybrid system.

- **Configuration similar to conventional automotive turbocharger**
- **Controllable turbine inlet and compressor inlet/outlet aerodynamics may be required**
- **No auxiliary power input to turbo-compressor**
- **Conventional bearings with unconventional seals**

The hybrid approach offers significant improvements relative the the all-scroll second generation CEM previously developed and tested, while maintaining the pressure/flow and turndown capabilities that made scroll attractive initially.

Parameter	Hybrid				Second Generation Scroll CEM
	Turbocharger	Scroll	Motor	Total	
Diameter (in)	6”	7”	7”	7”	12”
Length (in)	5”	8”	5”	18”	20”
Bulk Volume (l)	2.3	5	3	10.3	30
Weight (lb)	10	17	10	37	90

- Significant size and weight reduction as compared with the scroll-only system
- Achieves pressure/flow requirements of most fuel cell developers with good efficiency.
- Uses moderate-speed motor technology.
- Elimination of the motor from the high-speed centrifugal compressor shaft increases bearing design flexibility: Implementation of air bearings would be easier due to reduced bearing loads, but oil bearings with proper oil isolation seals would also be feasible.

Program success will be measured by the ability of the Hybrid TurboScroll CEM to demonstrate substantially improved weight, volume and manufacturing cost without sacrificing energy recovery performance.

- Key Technical Challenges
  - Fail-safe isolation of lubricant
  - System dynamics and control
  - Balancing turbo-compressor and scroll compressor performance characteristics
  - Weight, volume, noise and cost
- Key Program Challenges
  - Ensuring that target operating conditions are consistent with the needs of actual fuel cell operating points

System and subsystem trade-off analyses in our first phase of work will define the specific responses to our technical and programmatic challenges.